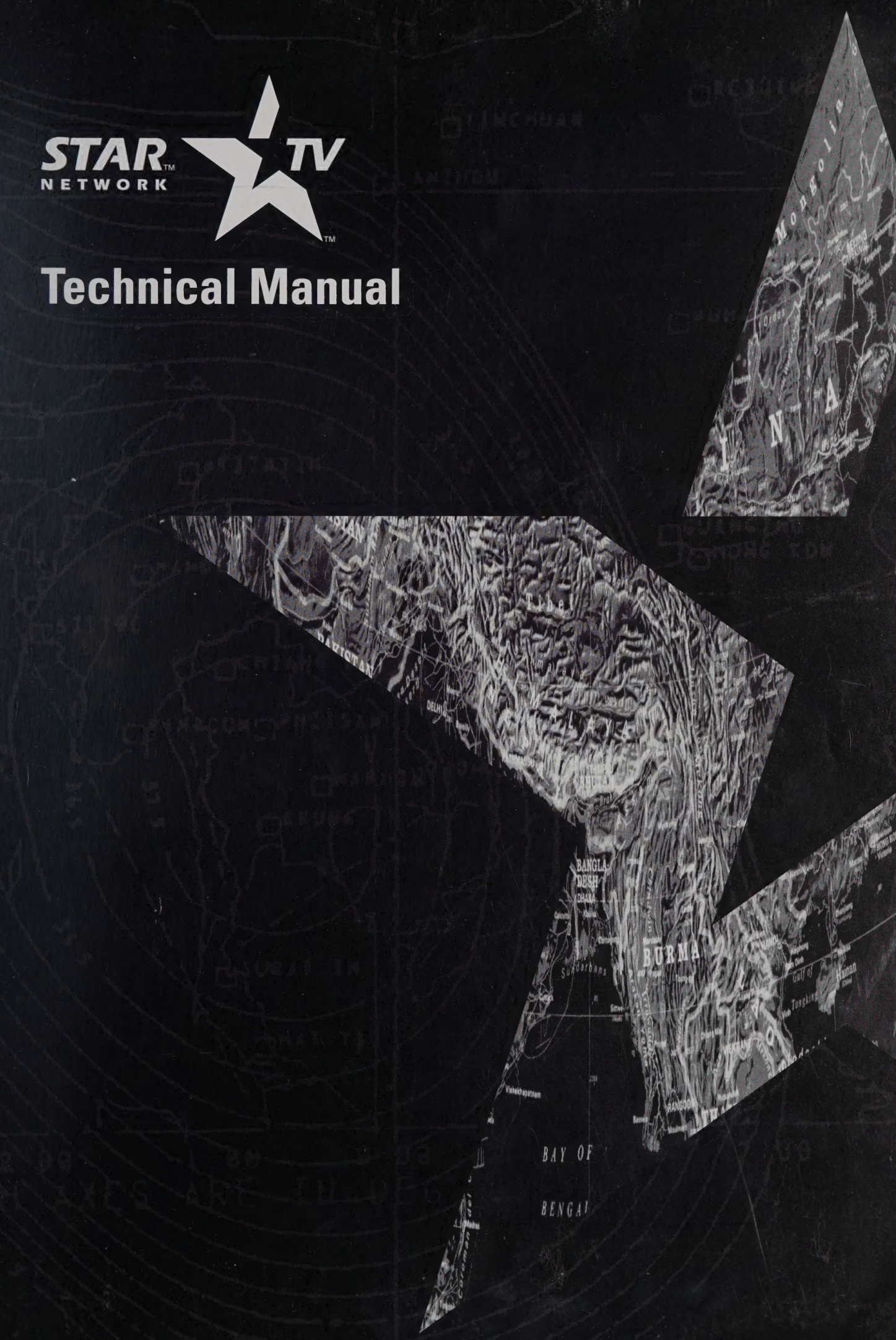
STAR™ TV
NETWORK

Technical Manual



Contents

Introduction

1. TVRO

2. SMATV

3. CATV

4. Headend Components

- 4.1 Satellite Antenna (Dish)
- 4.2 Feedhorn
- 4.3 LNB
- 4.4 Satellite Receiver
- 4.5 Modulator

5. Distribution System

- 5.1 Channel Allocation
- 5.2 Coaxial Cable
- 5.3 Distribution Amplifiers
- 5.4 Channel Converter
- 5.5 Tap-off Boxes
- 5.6 Splitter
- 5.7 Distribution Methods
- 5.8 Television Channels and Balancing Signals
- 5.9 System Upgrade
- 5.10 Evaluation of Distribution Systems

6. Testing Equipment

- 6.1 Signal Level Meter
- 6.2 Spectrum Analyzer

7. Scrambling Concepts

8. Appendices

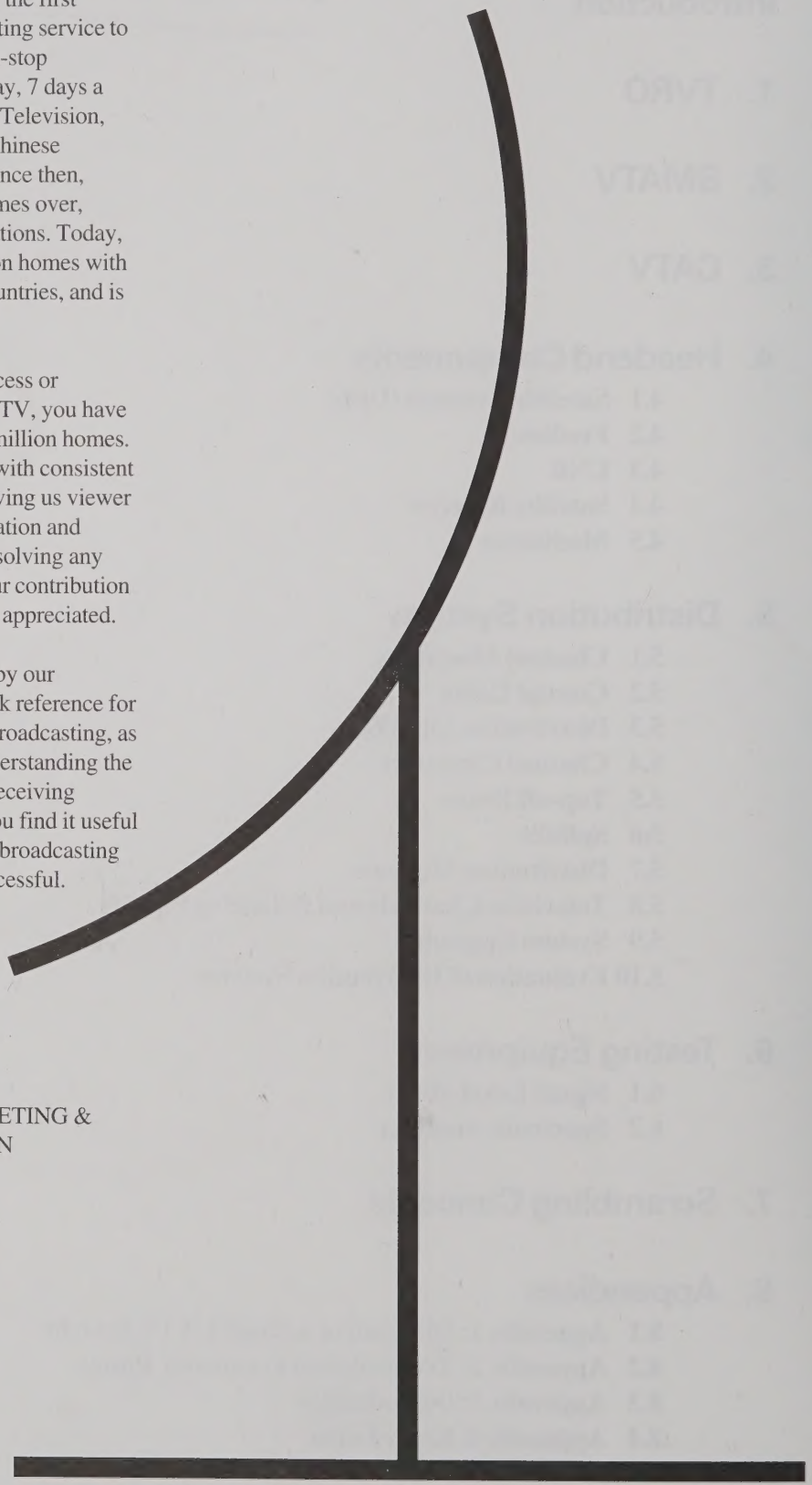
- 8.1 Appendix 1: Diagram of a Small CATV System
- 8.2 Appendix 2: Transmission Frequency Range
- 8.3 Appendix 3: Demodulator
- 8.4 Appendix 4: Reply Form

See Addendum

In 1991, STAR TV brought the first satellite television broadcasting service to Asia with 5 channels of non-stop programming, 24 hours a day, 7 days a week . BBC World Service Television, Prime Sports, MTV Asia, Chinese Channel and STAR Plus. Since then, STAR TV has grown ten times over, beyond all previous expectations. Today, our reach covers 11.3 million homes with 45 million viewers in 38 countries, and is steadily expanding.

As companies providing access or equipment to access STAR TV, you have helped us reach these 11.3 million homes. You have also provided us with consistent support and cooperation, giving us viewer information, market information and assisting us in locating and solving any broadcasting problems. Your contribution to this success is very much appreciated.

Here is a manual compiled by our engineers, to serve as a quick reference for technical terms in satellite broadcasting, as well as an easy guide to understanding the basic operation of satellite receiving equipment. We hope that you find it useful in keeping your business or broadcasting service trouble-free and successful.



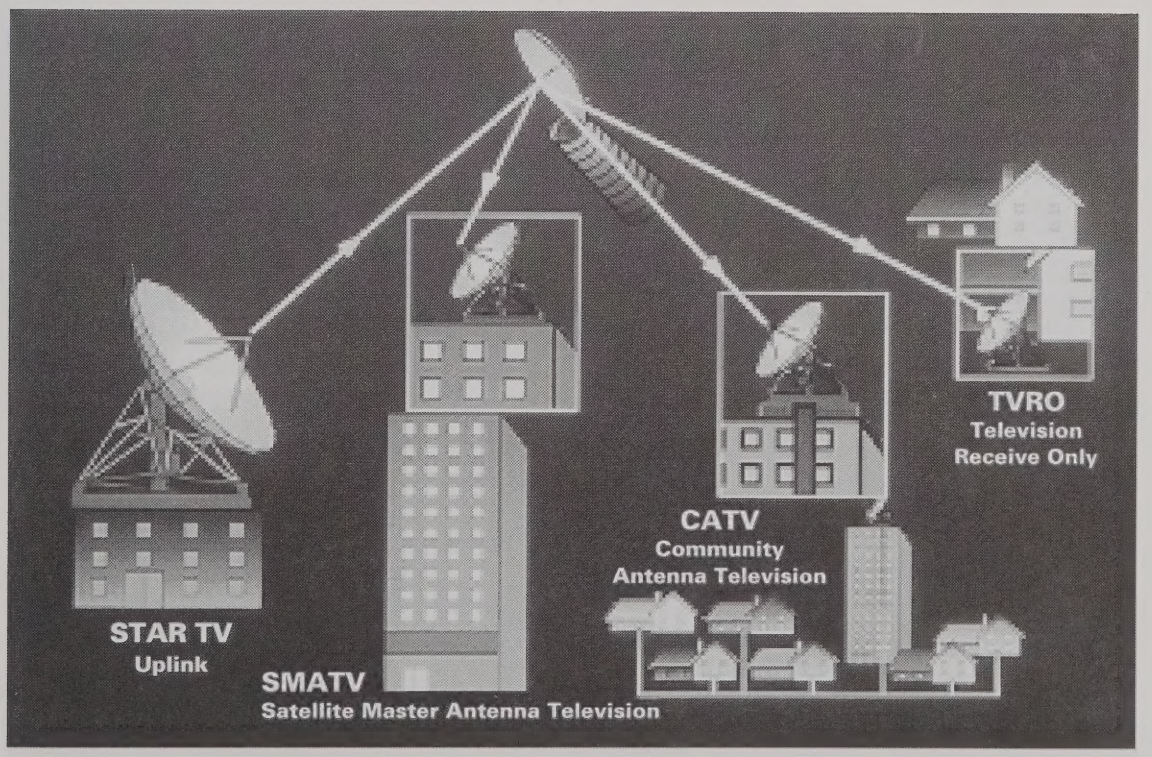
With compliments from:

STAR TV TRADE MARKETING &
DISTRIBUTION DIVISION

See Addendum

Introduction

Now that Asians enjoy relatively more leisure time and a higher standard of living than before, there is currently a rising demand for more and better entertainment services. Before the launch of AsiaSat I, Asians could access an average of only 2.4 channels. People in Western countries by contrast, had access to about 25 channels. Today, more than 11 million homes across Asia are able to receive 5 free-to-air STAR TV channels through different satellite signal distribution systems. The common systems used are TVRO, SMATV and CATV.

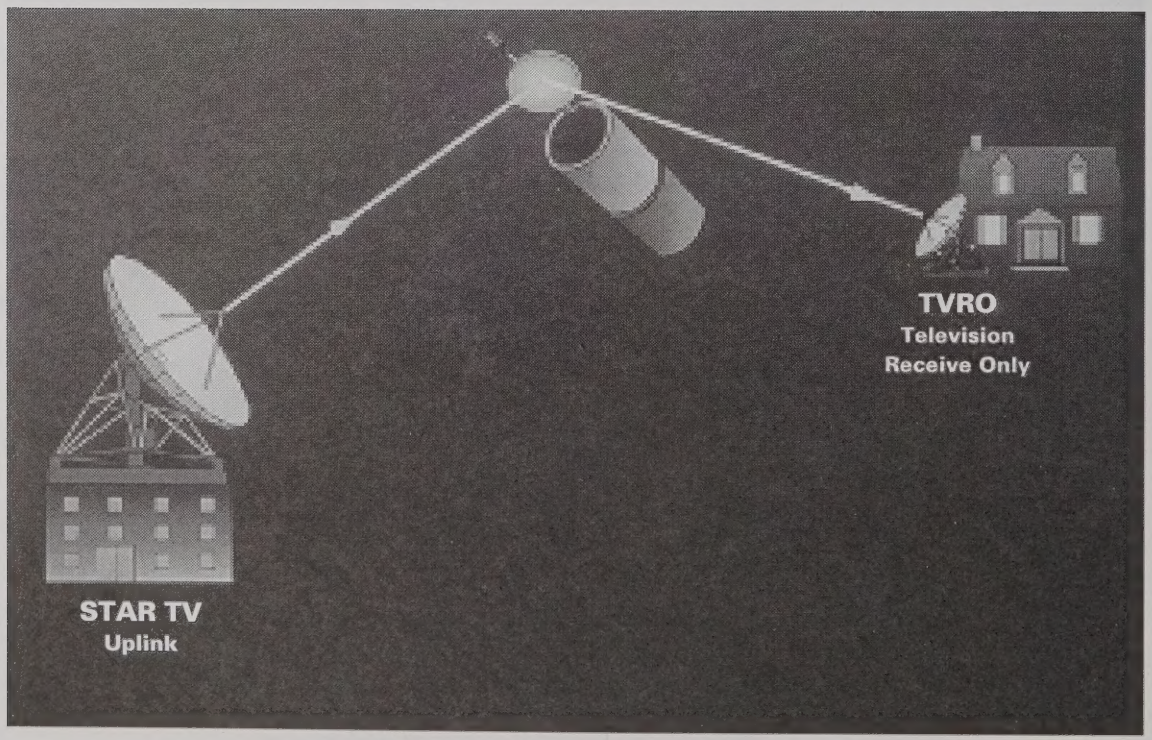


TVRO

1

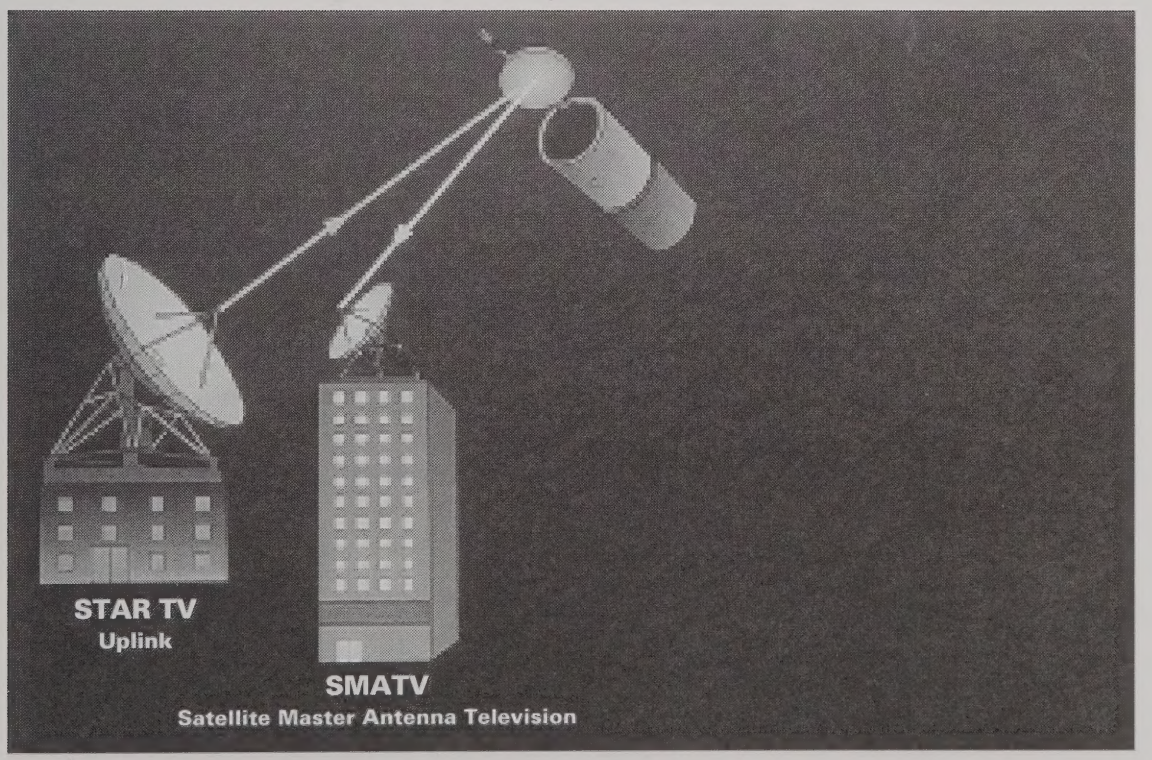
Television Receive Only (TVRO) system is one antenna connected to one household regardless of how many TV sets within the house are connected to the antenna. The connection is fairly simple and the owners enjoy complete independence with a TVRO system. They can choose their favourite channels together with appropriate audio.

TVRO has an advantage over other systems especially where STAR TV is concerned. STAR TV uses the Wegener Panda I system and gives viewers a choice of a maximum of 6 sound tracks. Viewers can also choose audio channels like mono or stereo by tuning their satellite receivers. With a steerable antenna of the appropriate size, viewers can also choose channels from a range of satellites with the help of a satellite positioner. In contrast with TVRO, the channels are fixed with SMATV or CATV systems, and complex distribution equipment is required for stereo broadcasting.



SMATV 2

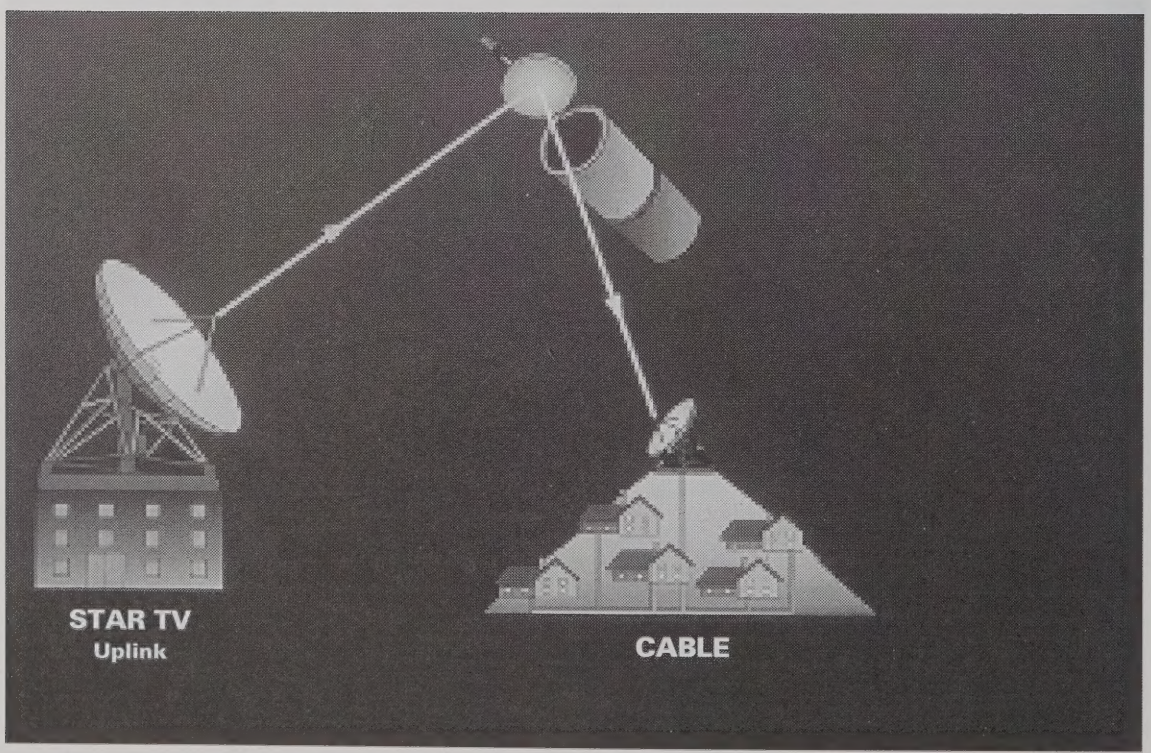
Satellite Master Antenna Television (SMATV) system is the preferred method of distribution for high-rise buildings and apartments. A headend is installed at a suitable point and here signals from local broadcasting stations and satellites are processed and combined. The signals are then modulated to either Very High Frequency (VHF) or Ultra High Frequency (UHF) channels and distributed via coaxial cable (or fibre optics in the near future) to subscribers. The cable is connected to the RF input in TV sets. Subscribers need only to tune their TV sets for the required channels just as they normally do for receiving local terrestrial channels. The complex headend components are all transparent to end-users . The other advantage of SMATV is that the average cost of installation is cheaper for each end-user as thousands of them are sharing the same system. Some installation companies provide free installation to tenants and collect monthly rental charges.



CATV

3

Community Antenna Television (CATV) is a system serving specific areas of a city. Signals from local terrestrial broadcasting stations, satellites, videotape and local studios (in-house) can be received, processed, combined and distributed to subscribers in high-rise buildings and apartments via underground or overhead coaxial cables or fibre optics. The operation of a CATV system is the same as that of a leased SMATV system, but it is not confined to one building. The signal can be transmitted to subscribers many kilometers away. Competition within the cable television industry is very fierce and cable operators have to find ways to attract subscribers. They do it by improving reception quality and increasing the number of channels. In countries like Taiwan or the Philippines, subscribers can enjoy up to 30 channels through a cable network.



Headend Components

4

1. Parabolic antenna (dish)
2. Feedhorn and Low Noise Block down converter (LNB)
3. Satellite receiver
4. Television modulator
5. Combiner, trunk amplifier, splitter, low-loss cable, etc.

We have already issued a manual on the transmission parameters for STAR TV and recommended specifications for the equipment required to receive STAR TV transmissions. In this manual, a brief description of some of the components required for forming a standard CATV system are listed. We hope this will be helpful to installers and cable operators when choosing the appropriate equipment.

4.1 Satellite Antenna (Dish)

An antenna is the main component of a satellite system. It is responsible for intercepting the weak satellite signal, concentrating and reflecting it to the feedhorn. It also acts as a filter for interference and noise.

Satellite dishes are generally parabolic in shape and can be either solid or of perforated metal sheet (mesh) in their construction. Choosing the type of dish should be based upon various factors like performance, surface and focal accuracy, weight, ease of assembly, wind loading and durability. For example, a one piece aluminum dish can have excellent surface accuracy but is not easily transportable to the installation site. Mesh dishes can be dismantled into smaller panels for easy transportation, but here the surface may not be perfectly parabolic if the framework and panels are not fitted together firmly. This results in lower dish efficiency. For small size dishes, fibre glass can be used. The quality of fibreglass dishes depends upon which manufacturing method is used to produce them. If they are curved and moulded properly, fibreglass antennas can have a very smooth surface and high accuracy. Fibreglass antennas have the advantages of being corrosion resistant and durable.

The gain and beamwidth are two important parameters governing the performance of antenna.

Antenna Gain

The bigger the dish, the larger the gain as the signal "captured" by the parabolic surface is greater. The size of the dish is directly related to the satellite EIRP (Effective Isotropic Radiated Power) available in the area. In places where the signal (EIRP) is stronger, a dish of about 1.8 metre can be used. However, in places which are located at the edge of our footprint, a dish of more than 6 metres is required. For detailed information, please refer to STAR TV transmission parameters and receiving specifications.

The gain of a dish is expressed in dBi (dB above isotropic source). For a C-band 10ft dish, the gain is about 40.2 dBi. When calculating the required dish size, efficiency is one of the most important factors to be considered. Efficiency is measured by the strength of the signal actually captured by the dish and feedhorn assembly. It is determined by factors like surface accuracy of the antenna reflector, the material of the antenna reflector and the position of the feedhorn and its support. In high quality commercial antennas, the efficiency can reach nearly 70%. Due to all these factors, different systems with the same dish size may still have varied performance.

Dish efficiency is also governed by the focus/diametre (f/D) ratio. On a dish with low f/D (0.3), if the feedhorn is mounted very close to the reflective surface, interference from the surrounding environment can be minimized. For antennas used for multi-beam purposes, high f/D (over 0.45) is more efficient.

Beamwidth

Another important factor in determining the dish size is the 3-dB beamwidth of the main lobe. The beamwidth will decrease with a corresponding increase in dish diametre. It is important that the beamwidth must be considered, because according to ITU, the minimum required separation between adjacent satellites is only 2.5 degrees. The signal reception from an adjacent satellite will be attenuated by 3dB only, which will cause interference in transponders having similar frequency and polarization, if the beamwidth is greater than 2.5 degrees.

Past experience has shown that this should be an important consideration when plans are being made to design and install satellite systems. In the northern footprint region, we have received complaints about interference on the BBC channel. After extensive investigation, we discovered that the interference was due to an adjacent satellite. A communications satellite had been activated in the 103 degrees East orbital slot, adjacent to Asiasat I. It has a television channel in transponder 10 with a frequency of 3875 MHz. This channel signal will be superimposed on the BBC channel whose frequency is 3880MHz if the antenna used to receive STAR TV is not of adequate size and quality to avoid interference from the adjacent satellite. The unwanted signal gets into the reception system and results in interference like crackling audio and picture break-up.

Most of the affected systems are using sub-sized antennas due to lower price and easy installation. Some of the interference can be minimized by re-aligning the dish so that the main lobe is slightly off of AsiaSat I, placing the adjacent satellite further down the main lobe, or preferably, in the first null. However, if this is not effective, the antenna has to be replaced with a larger one.

Specification manuals on STAR TV reception were distributed to manufacturers, distributors and installers in early 1990. In the manual we made recommendations after serious consideration of the complete operating environment. Good reception quality can easily be achieved by complying with these recommendations.

4.2 Feedhorn

The feedhorns serve the vital function of correctly "illuminating" the dish and capturing as much of the incoming signal as possible. It is critical that the proper feed be chosen to match the f/D ratio of the dish used. Deep dishes (f/D from 0.32 to 0.25) will use different feed configurations than shallower ones. Good feedhorns should have low insertion losses. This means that most of the signal captured from the dish will be transmitted to the LNB. A conventional C-band feedhorn connected to one LNB is capable of detecting either 12 vertically or horizontally polarized channels at one time. A probe within the feed must be rotated to receive the complement of 12 channels. (Refer to the manufacturer's instructions).

The most common feed encountered in SMATV installations is the orthomode feedhorn. This type of feedhorn can be connected to two LNBs. One LNB detects horizontally polarized signals and the other receives signals from the remaining 12 vertically polarized transponders.

4.3 LNB

The satellite signal received by the feedhorn is usually very weak and requires low-noise amplification and frequency down-conversion in order to feed a usable signal to the satellite receiver. The LNB is a devise consisting of a low noise amplifier and down-converter. The quality of the LNB is largely defined by noise temperature. C-band LNB noise temperature currently ranges from 25K to 60K, and a high quality picture can be obtained with a low temperature LNB.

4.4 Satellite Receiver

Satellite receivers are the main components of a satellite system. There are many kinds of receivers available in the market and end-users are often faced with difficulties in choosing the appropriate one. STAR TV has a standard procedure for testing satellite receivers at the uplink office in Clear Water Bay, Hong Kong and will carry out extensive receiver tests for manufacturers' new products.

Receivers can be roughly divided into two categories, namely consumer grade and commercial grade. Consumer grade receivers are mainly used in TVROs and equipped with remote control. Commercial grade receivers are used for SMATV or CATV installations and are often rack-mounted and designed for continuous operation.

The quality of a receiver is judged mainly by clarity and fidelity of the television picture and crispness of the sound. These are all related to the IF band-width, receiver threshold, frequency stability and tuning method used which, in turn, are determined by the circuit design and choice of components

IF Band-width

STAR TV's broadcasts are relayed with a 30 MHz band-width. However, a viewable television picture can be reproduced using a receive IF band-width as low as 15 MHz. Picture fidelity worsens as the receiver band-width narrows. Picture details are slowly lost and colour shades begin to vary. However, receivers with narrower band-width detect less noise power, so unwanted "sparklies" are avoided. Thus clarity has to be traded off for picture fidelity.

It has been found that picture quality obtained with a 24 to 28 MHz band-width is virtually indistinguishable from that with a 30 MHz band-width. So the lower band-width has been adopted as an industry standard for satellite receivers. Home satellite receivers often use a band-width of 27 MHz to minimize noise. Some brands even come equipped with a front-panel adjustable band-width knob – a very valuable feature.

Receiver Threshold

The threshold of a satellite receiver determines how weak an input signal can be before a picture is judged unacceptable. This is measured by the carrier power to noise power ratio (C/N). The concept of C/N can be clearly understood by imagining yourself in a room full of people. If everyone were speaking and the noise level was high, someone would have to shout to be heard. If it were so quiet that you could hear a pin drop, a whisper would suffice.

If the C/N fed into a receiver is plotted against its output video signal to noise power ratio, S/N, a straight line results. This linear relationship means that for a given change in input, there is a proportional change in output. The threshold is measured at that point where the deviation from a linear or straight line is one decibel. Near or below threshold point, "sparklies" begin to appear. Most receivers have thresholds at C/Ns of about 8 deciBels (dB).

Receiver Tuning

Commercial grade receivers should be tuned on the panel and the tuning knob should be covered properly after setting up, to avoid any frequency shift due to human error during servicing.

Some consumer grade receivers are equipped with an on-screen display. An on-screen menu is shown once you press the menu button. The general features may include video tuning, audio tuning, audio de-emphasis, video (IF) band-width and channel selection. Extra features like parental lock, channel skip, timer control and polariser select are optional and are made available depending mainly on the price and demand.

Audio Quality

Audio quality also varies between satellite receivers. The audio should be easy to tune over the full 5 to 8.5 MHz range. STAR TV uses Wegener Panda I system for audio transmission.

The best reception of our stereo and multi-lingual programming can be enjoyed with receivers that are compatible with the Wegener Panda I sound system. Unlike normal mono sound TV channels which carry only one sound track, each of STAR TV's five channels carries at least four narrow-band audio subcarriers: two for stereo sound and two for additional languages. This is achieved by the Wegener system's unique compression and noise reduction technology.

At STAR TV's uplink site, the state-of-the-art Wegener system compresses the sound signals. As a result, more information sound can be compressed into the same amount of space. Under optimal conditions, the Wegener Panda I system can offer not only stereo sound, but as many as four additional sound tracks, giving our viewers a total of six tracks to listen to. When a Wegener Panda I compatible satellite receiver picks up the broadcast, it expands the compressed signal to its original form.

As the sound is delivered to the TV set, the viewer can select either stereo sound or any of the other languages provided by the broadcast. In case of TVROs with a Wegener Panda I compatible stereo receiver, viewers would be able to pick up and select all sound tracks including stereo and multi-lingual tracks, which STAR TV has transmitted.

For SMATV/CATV systems too, a Wegener Panda I compatible receiver is required to decompress the Wegener Panda subcarriers, and to select the desired audio channel. The audio channels are remodulated together with the video channel to a VHF or UHF signal which a TV set can read. This modulated signal is then delivered down to the cable system wired to an apartment (SMATV) or under a geographical area (CATV). To enjoy STAR TV's multi-lingual transmission, individual households need only to plug the TV set into a wall outlet that is provided as part of the SMATV/CATV system.

STAR TV subcarriers assignment are as follows:

Northern Beam	Southern Beam	Assignment
5.58 MHz	6.30 MHz	stereo pair 1 left
5.76 MHz	6.48 MHz	stereo pair 1 right
5.94 MHz	6.66 MHz	stereo pair 2 left or monaural 1
6.12 MHz	6.84 MHz	stereo pair 2 right or monaural 2
6.30 MHz	7.02 MHz	stereo pair 3 left or monaural 3
6.48 MHz	7.20 MHz	stereo pair 3 right or monaural 4

Many receivers in the market are not equipped with Wegener Panda demodulating circuit and will receive a degraded audio signal. In order to look after their interests, STAR TV has been transmitting a wide-band mono subcarrier in each beam. It is located in 6.20 MHz in the northern beam and 6.80 MHz in the southern beam. The problem of degraded audio sound can be solved. However, only mono sound is received.

Owing to the vast numbers of mono receivers in the market and demand for higher sound fidelity, an audio demodulator has been developed to upgrade a mono receiver to a Panda-compatible stereo receiver. Details of the demodulator are in the appendix.

4.5 Modulator

This is a device which converts the baseband video and audio signals to a form that standard television receivers can recognize. This equipment transforms the composite video and audio into either a UHF or VHF signal. The video signal is amplitude modulated; the audio signal frequency modulated.

Most home satellite receivers contain built-in modulators that are typically housed within a metal box mounted on the rear panel of the receiver. The box is used to shield the modulator from the rest of the circuitry in order to prevent RF interference.

A modulator has several inputs including audio, video, power and possibly a channel switching or pass through switching select input. Most models also feature an off-air antenna input which is simply passed directly through to the TV output when the satellite receiver is switched off and not in use. In cases where a SAT/TV switch is present, the off-air television signal is passed through whenever TV is selected.

Modulators are available in fixed and frequency-agile models. Fixed frequency units are channel specific and have to be ordered directly from the factory with the desired output channel pre-set. In contrast, frequency-agile modulators are tunable and can be field-adjusted to any desired frequency. Fixed channel modulators are typically less expensive than frequency-agile ones. The choice of modulators usually involves a trade off between requirement and price. For fixed channel re-broadcasting, a less expensive fixed frequency modulator is required in order to lower the total investment. However, spare frequency agile modulators should be kept handy for emergency replacement.

Modulators used for re-broadcasting are usually for 'skip channel' purposes. However, owing to limitation of the frequency spectrum, modulators equipped with SAW (surface acoustical wave) filters are employed. These filters have a very sharp cutoff frequency and are suitable for re-broadcasting adjacent television channels. Those not incorporating good quality SAW filters may generate a "dirty" signal which can interfere with an upper or lower adjacent channel. Note that not all SAW filters are high quality devices and a CATV operator must closely examine the specifications of any components that will be purchased. It is also quite important to understand that consumer grade receiver modulators do not provide either sufficient filtering or output gain to justify their use in commercial systems.

A typical modulator has an output level ranging from 30 to 60 dBmV. When feeding a small SMATV system in which the mixer combiner output is not amplified, a modulator which generates a relatively high output must be chosen. However, if the mixing losses are high enough to warrant a higher gain, a headend launch amplifier together with a low power modulator make the best combination. A higher output power modulator generates substantial heat and will affect the output S/N. Therefore, it is better to use a high gain broad band launch amplifier which then allows the employment of a lower power modulator.

Both audio and video output as well as the RF output are adjustable. The audio and video settings control the "percentage of modulation" or how much of these signals are added to the channel carrier. Higher video outputs make for brighter television pictures but extremely high levels produce a buzz in the audio and washed out pictures. Most cable-ready modulators often have the audio output preset at the correct point – 15 to 17 dB below the video carrier level. The RF adjustment sets the output voltage level to the distribution system.

An important consideration while choosing modulator specification is the level of spurious output signals present. These unwanted signals can interact with adjacent channels resulting in a wide variety of annoying distortions. Generally, a -55 dB or better spurious output rating relative to the video carrier level is sufficient to eliminate any visible picture distortions. In those cases where a modulator with poor output specifications has to be used, a bandpass filter may be a partial solution, at the expense of output

level and perhaps, flatness of frequency response. Note that frequency-agile brands tend to have slightly higher amounts of spurious outputs.

Other principle factors that determine the type of modulator purchased are reliability and the need for service. Modulator failure, in addition to causing the loss of one channel, can create problems on adjacent channels as well.

The specifications of a typical modulator are as follows:

Modulator

Parameter		Specifications
Video	Input type	Composite PAL or NTSC
	Input level	1 V p-p
	Max. Video modulations Depth	87.5%
	Differential phase	<3 degrees at 4.43 MHz
	Differential gain	<3% with 4.43 Colour Subcarrier
	Frequency response	± 1 dB (50Hz- 5MHz)
	Input impedance	75 ohm
	Signal to noise ratio	50 dB nom.
Audio	Input level	0.45 V 10%(30-46K modulation)
	Input impedance	4.7 K
	Signal to noise ratio	46 dB
	Frequency response	± 1.5 dB (50 Hz – 15 KHz)
RF	Output channel	Standard CATV channels
	Output level	40 dBmV
	Output control range	10 dB continuously variable
	Frequency stability	20 KHz
	Spurious output	> 65 dB (47-450 MHz)

Cable TV Converter

The competition among CATV operators is fierce, and more channels are included in a network in order to attract more subscribers. There are still a lot of old model TV sets on the market which can only be tuned to 8 channels and render cable networks with more than 8 channels unavailable to the owners. Fortunately, a cable TV converter can alleviate their problem.
The specifications of TV converters are as follows:

TV Converters	Specifications
Input Band-width	48MHz-470MHz
Input Channels	VHF CH 2-12
PAL B system	CH S3-CH S41
Output Channel	VHF CH3/CH4
Power Gain	0 – 8 dB
Noise Figure	13 dB nom.
Osc. Stability	±300KHz
Osc. Leakage	-10 dBmV
Input Return Loss	6 dB
Output Return Loss	8 dB
Power Supply	220V AC, 50Hz
Power Consumption	15 Watts

Other features of TV converters include wireless infra-red control, direct channel selection, favourite channel memory, favourite channel scanning, sleep time control and last channel recall.

Distribution System 5

The purpose of every private cable design is to generate programming signals in the headend and to distribute them to each outlet with enough energy to produce an excellent quality picture and clear audio. This task can only be fulfilled by having a well-designed distribution system with appropriate equipment such as a high gain amplifier, low loss cable and other accessories.

A well-designed distribution system is one which will resist interference from local television stations, other carriers, electrical noise and distant TV stations. It should also prevent signals from leaking and causing interference to other communication service bands.

5.1 Channel Allocation

Many private cable systems distribute more than 12 channels to subscribers. This requires the use of either the mid-band, super-band, hyper-band or UHF channels, in addition to the twelve available VHF slots. In general, the midband channels are first to be considered because cable, splitter, tap and other losses have similar low values as those encountered in VHF-systems. Mid-band headends are also quite similar in design and operation to those used for either low-band or high-band VHF channels. Once the seven mid-band channels have been occupied, 10 super-band and 21 hyper-band frequencies are available.

In some countries, only UHF is assigned for TV re-broadcasting as all other bands are allocated for other communication services. A complete listing of all channel frequency assignments is shown in the appendix. The channel we refer to here is the PAL format which has an 8 MHz channel band-width. For NTSC, channel allocation is mostly similar except for a 6MHz channel band-width.

Distributing broadcast signals in the mid, super and hyper-bands has its advantages and disadvantages. The obvious benefit is that more channels are available and this is enough for a CATV system. In addition, no modifications in headend or distribution design, or special components are necessary when using the mid-band channels.

The major disadvantage in using these bands is the need for either CATV-type converters or cable TV-ready televisions. Most standard sets are only equipped to tune in VHF and UHF channels. Using converters is an extra expense and they can reduce a system's reliability. In addition, converters do not necessarily interface with the existing remote control capabilities of standard televisions.

Mid-band distribution systems can also suffer from interference caused by second-order distortions generated in old line amplifiers. Such spurious signals are produced when the sum frequencies of low-band VHF channels are amplified. This causes picture distortions in some higher mid-band channels, and can be avoided with careful designing.

When distributing UHF channels, two factors must be considered: (1) UHF tuners are not as sensitive to input signals as VHF tuners. UHF input signals to televisions should be of a minimum of 5 dBmV in order to achieve professional quality pictures. (2) Loss of signal in coaxial cables, taps, splitters and other passive devices are substantially higher. Therefore, the signal must be launched from the headend with more power than would normally be used with VHF distribution. Some of the main components of a distribution system are discussed here for reference.

5.2 Coaxial Cable

Signals from the headend are transmitted to viewers via coaxial cable. The picture quality is mainly determined by the performance of the coaxial cable. Cable loss is directly related to frequency and some examples are given as follows.

Loss in dB per 100 meter Frequency (MHz)	59 Foam Series	6 Foam Series	11 Foam Series
55	6.73	5.25	3.15
83	8.04	6.40	3.87
187	11.81	9.35	5.74
211	12.47	10.00	6.23
250	13.45	10.82	6.72
300	14.60	11.64	7.38
350	15.75	12.63	7.87
400	16.73	13.61	8.53
450	17.72	14.43	9.02
500	18.70	15.29	9.51
550	19.52	16.08	9.97
600	20.34	16.73	10.43

From the above table, it is evident that at 600MHz the difference in loss between a 59 series cable and a 11 series cable is about 10 dB. The losses will be even higher at UHF frequencies and that is why good quality cable should be used .

Conversion Factor

The loss of cable at certain frequencies can be calculated by using the conversion factor. It is done by multiplying the known loss at a certain frequency by the conversion factor of the required frequency. The conversion factor is equal to $\sqrt{f2/f1}$.

E.g. For 59 foam series, loss at 400 MHz is 16.73 dB and we want to find the loss at 600 MHz.
That means, f2 = 600MHz and f1 = 400MHz.
Conversion factor = $\sqrt{600/400}$ =1.224
Loss at 600 MHz = 1.224 X 16.73 = 20.48 dB
Similarly, loss at 700 Mhz = $\sqrt{700/400}$ X 16.73 = 22.13 dB

5.3 Distribution Amplifiers

Distribution amplifiers for CATV installations are designed to deliver high output levels. These amplifiers can typically reach their full output levels with just a 20 dBmV input. For example, a distribution amp generating a 55 dBmV output should have a gain of at least 35 dB. Also, these components have a specified maximum permissible input. An excessive input can cause an amplifier to overload and generate distortions. The average maximum input specification for a typical distribution amplifier is 10 to 15 dBmV. While distribution amps can have either fixed or adjustable gains, most usually have a 10 dB adjustment range. Manufacturers specify the maximum permissible output so that gain can be reduced if input levels are too high.

Distribution amplifiers used to generate headend output signals are also known as launch amplifiers. As a general rule, if the input signals are strong and steady; all channels are relatively well-balanced in strength; and the maximum headend output is less than 60 dBmV, a broad-band launch amplifier is usually sufficient.

The noise figure is not of great concern in line amplifiers because, at this point in a distribution system, the input signals and the SNR should be sufficiently high. Typical noise figures range up to 10 dB and 15 dB for the VHF and UHF range, respectively. As amplifiers are cascaded down a distribution line, the noise power can add up to the point where it might become a concern. In this case we should choose amplifiers with a low noise figure.

Some amplifiers are designed to have their gain increase with frequency to compensate for cable tilt. The tilt is the increase in attenuation of signals at higher frequencies, due to higher loss at these higher frequencies. The difference in signal level will be about 10 dB between the lowest channel and the highest channel. By properly adjusting the tilt in the distribution amplifier, the output at the end of the drop cable would be flat across the entire range of frequencies.

The tilt can also be adjusted by inserting tilt compensators before the distribution amplifier input, on long cable runs. If tilt has not been corrected before a distribution amplifier input, the higher frequency channels will exit at a level well below its maximum output capability. This may not be an appreciable problem in shorter cable runs, but an amplifier's internal slope control cannot adequately deal with excessive levels of tilt.

Distribution amplifiers are broadband devices which are susceptible to various types of output signal distortions. These result from the non-linear interaction of input signals of various frequencies within an amplifier. Second order distortion occurs when two signals beat together to produce sum and difference frequencies. In a system carrying the VHF channels, second order beats can show up in the mid-band and in the super-band as diagonal lines running across the television picture. Second order products should be at least 55 dB below the main signal level.

Third order distortions, caused by the interactions of three or more frequencies, include cross modulation and composite triple beat. Cross modulation distortions occur when the modulated signal on one channel bleeds into the output of another channel. The chance of cross modulation increases with increases in the number of channels and the signal level. Cross modulation is then visible as vertical or horizontal bars moving through the screen. This occurs because the TV receiver is confused when two or more sync pulses are present at one time. As cross-modulation becomes progressively worse, complete pictures from one or more channels will be seen in the background. Second and third order distortions can be reduced by maintaining the output of an amplifier within its specified operational capability. The general characteristics of a distribution amplifier are listed for reference:

Specifications for a CATV Distribution Amplifier

Item	Specifications
Frequency Range	45-450 MHz, 470-860 MHz
Frequency Response	± 1dB
Max. Gain	50 dB
Gain Control	0-20 dB adjustable
Attenuator Pads	0,3,6,9dB selectable
Slope Control	0-12dB adjustable
Equalizer	0,12,22.5dB option
Max. Output Level	110dB (for NTSC 36 channels input) (for PAL B 28 channels input)
Noise Figure	7- 9 dB
Input/Output Return Loss	16 dB nom.
Cross Modulation	-75dB: 50 dBmV
Second Order	70dB: 49dBmV
Composite Triple Beat	57dB: 49dbmV
Hum Modulation	70dB

5.4 Channel Converters

Converters are for transposing a channel received into another channel being more suitable to the distribution system. The reasons for conversion are:

1. Transposing a channel of a higher frequency (UHF signal) into a lower frequency range with less distribution attenuation.
2. To avoid interference caused by neighbouring channels.
3. To prevent interference by direct radiation of strong local stations to the TV sets. This particular point must be carefully observed when planning bigger antenna installations.

5.5 Tap-off Boxes

A tap directs a portion of an incoming signal to each subscriber drop while allowing most power to pass through to its output. Taps allow the high signal level present in most distribution cables to be tapped off at the substantially lower level required by each television set. A tap can also be used in reverse as an injector where two uneven signals must be combined with the high isolation provided between output ports.

A tap creates two kind of losses, insertion and isolation. Insertion losses range from under 0.3 to over 3.7 dB and more depending on the tap value. Isolation loss is determined by the rated tap value. Each tap attenuates the signal it receives from the line, according to the value of the tap. For example, a 35 dBmV signal entering a 20 dB tap results in an output signal of 15 dBmV.

When designing a distribution system, the insertion loss for all taps must be added together to calculate the total loss. The cable loss should also be considered when selecting tap values and it should be able to provide 0 to 10 dBmV to every TV set. Specifications of some common tap-off boxes are shown below:

	15 dB Tap		20 dB Tap		25 dB Tap	
	VHF	**UHF**	**VHF**	**UHF**	**VHF**	**UHF**
Branch attenuation dB	15	16	20	20	25	25
Throughpass attenuation dB	2	2.3	1.3	1.5	1	
Mutual attenuations between the branches outputs	26	26	32	32	32	32

5.6 Splitter

When it is necessary to divide a CATV transmission line, special devices are used to maintain the impedance match. These devices are commonly referred to as splitters, and are designed to present a 75 ohm characteristic impedance to all branches of the line. A two-way line splitter is constructed with tapped transformers in a circuit configuration designed to divide equally the power between the two branches while maintaining the 75 ohm characteristic impedance in all branches.

Three-way and four-way line splitters are actually combinations of two-way line splitters. For example, a three-way line splitter consists of a two-way line splitter with one of the branches being split again. Therefore, the branches of a three-way line splitter will have outputs that are 6 dB down on two of the branches and 3 dB down on one of the branches. A four-way splitter will have both branches split, and thereby all four output branches will be down 6 dB. Of course, these are the ideal or theoretical values, and in actual practice the losses will be somewhat greater depending upon the Q factor of the coils and efficiency of the transformer circuitry. Actual loss values are usually about 3.25 to 3.50 dB in each two-way split while a four-way splitter will have outputs that are 6.5 to 7 dB down from the input level.

Some addressable distribution systems place unusual requirements on tap-off and splitter design. DC power and low frequency addressing data must be allowed to pass through these devices while RF integrity is maintained. When purchasing these advanced systems, a number of factors should be considered. DC bypass coils must be able to handle in excess of the maximum current expected on the

system. This will prevent both the saturation and burn out of the bypass coil. Also electrolytic corrosion between dissimilar metal contacts is much greater for devices carrying DC power. So these advanced taps and splitters must be examined with this possibility.

5.7 Distribution Methods

Two types of distribution systems can be designed using either taps or splitters. In general, splitters are used for smaller systems. Designs ranging from larger SMATV systems to enormous cable TV networks use trunk lines and feeder cables with taps. A main trunk line is never tapped. It uses only splitters and amplifiers so that the distribution system is well protected from ingress interference. The taps are used in feeder lines.

1. Tap-off system

In this system tap-off lines are branched off from trunk lines to supply radio and TV signals to outlet sockets . By means of high decoupling devices incorporated in the tap-off boxes no interferences caused by cable shorts or interruptions will affect the trunk line and other subscribers. This system is strongly recommended for installations in apartment houses, compounds of villas, hotels, schools and hospitals; also for antenna systems being installed in older buildings.

2. Loop-wired system

In this system the outlet sockets are connected directly to the trunk lines. To prevent line reflections, the number of sockets connected to one trunk line should not exceed seven. Loop-wired systems are more economical with regard to the amount of material needed. However, manipulation of the outlet sockets by subscribers will interfere with the antenna system. Loop-wired systems are preferable for installation in villas and inside of bigger apartments.

The specifications for a small CATV system for two blocks with 18 floors each is used here as example and shown in the appendix.

Details of components used:

1.	TV antenna and Satellite antenna
2.	Headend amplifier station
3.	Tap-off box, 1-way , -20 dB
4.	Tap-off box , 2-way, -20 dB
5.	Tap-off box , 2-way, -15 dB
6.	Splitter, -4dB
7.	Distribution box, 3-way, -7dB
8.	Distribution box, 3-way, -9dB
9.	Outlet socket, flush type
10.	Coaxial cable, 1.1/7.3 mm (diameter of inner conductor/diameter of outer dielectric)
11.	Coaxial cable, 0.7/4.3 mm
12.	Repeater amplifier
13.	Cable connecting box

Block No. 1 is antenna array and headend fixed on a flat roof.

Block No. 2 is connected to Block no.1 by means of underground coaxial cable. Distribution amplifiers are located in a duct on the ground floor.

Similar arrangements can be designed for a CATV system with underground or overhead cables running across streets. Each district can be considered as a single block and linked by repeater amplifiers.

5.8 Television Channels and Balancing Signals

Whenever signals are modulated onto two adjacent channels there is always the possibility that interference will occur. Therefore, a set of non-adjacent, off-air broadcast channels were allocated in each region of a country to prevent signal interference. Thus, in Bombay, for example, channels 4 and 6 are used for Doordarshan I and II, while in New Delhi channels 4 and 7 are used.

CATV systems may be designed to relay two off-air channels along with five satellite TV broadcasts onto the VHF television band. Headends process and transmit adjacent channels and must be designed so that each one is received without interference from all the others. The UHF band can also be chosen as a target for modulation, but cabling losses are higher here than in the lower frequency VHF band. Therefore, extensive distribution systems will often be designed to use the VHF and mid-band range.

Each television broadcast has its video, colour and audio information organized according to CCIR recommendations. The channels' band-width of PAL B is 7 MHz with a 5.5 MHz separation between audio and video signal. If the audio signal power is too high, it can bleed into the upper adjacent channel video and cause a cross hatch or pattern over the picture. If the video band-width has not been cut off or filtered below the lower channel edge, it can bleed into the lower adjacent channel and cause scratching sounds and "crosstalk" on its audio output. Therefore, whenever adjacent channel modulation is used, two rules must be followed. The signal must be restricted by a bandpass or SAW filter to protect the lower adjacent channel and the audio level must be 15 dB below the upper adjacent video channel.

5.9 System Upgrade

There are two ways to upgrade existing systems so that more channels can be accommodated. The first one is to shift the network from VHF to UHF and the second is to upgrade the system with adjacent channel modulators.

Although the cable laying and equipment upgrade in shifting the network from VHF to UHF are costly, it is a long-term solution. The use of a set-top converter is ideal for subscribers who do not want to discard their VHF TV sets.

The latter is a quick and less expensive solution, which is especially suitable for small to medium size networks. By using adjacent channel modulators, all the 12 channels in VHF band can be fully utilized and further expansion is possible by using the mid-band spectrum.

5.10 Evaluation of Distribution Systems

The design of a CATV system involves determining the most efficient use of the selected cable and components to provide service to the area being considered. As the trunk system is not tapped for subscribers and only serves to provide transmission to the distribution points, it should be as short and direct as possible and a low-loss cable is necessary. In order to accommodate the coverage of larger areas without degradation, it is sometimes necessary to use a larger cable, which will reduce the number of amplifiers in cascade to a manageable quantity.

The normal practice is to use 1.27 mm foam dielectric aluminum-sheathed +connection. The primary objective of the distribution system is to provide signals of an adequate level to the subscriber's television receiver. An acceptable subscriber level is 0 to 10 dBmV. Input levels lower than 0 dBmV may result in 'snow' as a consequence of the receiver's noise figure, and input levels in excess of 10 dBmV may result in an overloading of the receiver's input circuitry, which produces cross-modulation or adjacent channel interference.

In order to provide the required signal level at the subscriber's connection point, the tap is selected to attenuate the signals to approximately 12 dBmV. These taps have either flat or tilted response characteristics to produce an approximately flat level of the various channel signals at the subscriber's

receiver. The highest practical undistorted output level should be used in the CATV distribution system to permit the best use of high value (low insertion loss) taps, and reduce the need for additional amplification. By tradition, the amplifiers used on the distribution or feeder system are referred to as line extender amplifiers.

The distribution system is connected to the trunk transmission system through bridging amplifiers. These bridging amplifiers, or bridgers, are designed to provide considerable isolation for the trunk system. The bridging amplifiers are fed from a directional coupler circuit of sufficient gain, inserted in the trunk cable, to provide the high levels of gain required in the distribution system. Provision for up to four distribution outlets is included to accommodate the various distribution arms necessary to feed the area being served. The ac power fed through these arms is separately fused to isolate any possible trouble with a particular arm which may have a defect or accidental short circuit.

Testing of the CATV distribution system involves the following factors:

1. Noise
2. Cross-Modulation
3. Hum Modulation
4. Power Supply Regulation
5. Frequency Response
6. Automatic Gain Control (AGC)
7. Subjective Signal Quality Evaluation

Noise tests are done to determine the amount of interference on the system generated by thermal agitation effects in the amplifiers. An ideal 75 ohm, 4 MHz television channel will have an irreducible level of noise equal to about -59 dBmV at 70 F. This noise will be increased by the noise figure of the first amplifier. If subsequent amplifiers have identical noise figures, the noise will then increase by 3 dB every time the number of cascaded amplifiers is doubled. This noise factor determines the minimum input signal level which may be allowed, depending upon the number of repeater amplifiers operating in the cascade.

The objective of a noise test on a CATV system is to obtain a measurement which will indicate how far the level of the noise interference is below the operating signal levels of the various TV channels carried on the system. The measurement is actually made in terms of carrier to noise (C/N) rather than signal-to-noise (S/N) as it is sometimes called. Peak carrier values as measured on the system are used as a reference, requiring the use of a substitute unmodulated CW carrier in order to avoid the fluctuations resulting from the video modulation changes that occur on TV channels operating on the system. The signal levels are normally measured using an unmodulated CW carrier adjusted to the normal operating level of the system, and then repeated with the carrier removed from the system and the system input terminated with a 75 ohm impedance.

Cross-modulation testing measures the "cross talk" which interferes with the desired television channel. The initial indication is a non-synchronous horizontal blanking bar which creates the effect of a horizontally moving vertical bar. This is caused by a spurious horizontal synchronous pulse leaking into one channel from another as a result of overload distortion of the repeater amplifier.

It is difficult to measure the cross-modulation ratio in a system and extensive techniques are required. It can be done by providing synchronous modulated signals on all channels except the particular channel under test. A 15,625 Hz square wave is used for modulation of all channels except the channel under test, which is an unmodulated CW picture carrier. The test equipment is set up to measure the amount of 15,625 Hz modulation that leaks from the other channels carried on the cable system into the unmodulated channel's frequency.

Hum modulation is a form of interference which produces alternate dark and light horizontal bars across the TV screen. These bars may roll slowly up or down through the picture. One bar indicates a 50 Hz or 60 Hz spurious signal and two indicates 100 Hz or 120 Hz interference. Hum modulation of 50 Hz may be caused by inadequate DC power supply filtering from half-wave rectification circuits or from saturated bypass coils. Hum of 100 Hz is usually a result of low voltage (AC) furnished to the amplifier power supplies, causing them to cease regulation.

The test is performed by tuning a connected signal level meter to a channel, demodulating and rectifying the video information, and displaying the rectified output on an oscilloscope. Hum modulation of 2 % of the peak video level is generally regarded as acceptable, with 1 % or less being practically undetectable.

Power supply regulation tests are done to determine the vulnerability of the system to AC voltage variation. Operating systems are often furnished with AC power at a nominal 220 volts RMS, but the actual voltage may vary as much as ± 20 volts. Therefore the regulated circuitry of power supply serving the cable system should accommodate this input variation.

Frequency response of a CATV system must be maintained within reasonable limits to prevent gross differences in the levels of various channels at the system extremities. Individual television channel response should have a flatness of about ±1 dB and ± 3 dB usually across the entire band-width, for undegraded reception.

A summation sweep-frequency test is necessary to achieve the desired level of response flatness. This involves the replacement of the regular TV channel source at the head-end with a swept-frequency RF generator and slight amplifier alignment correction for very small response variations, which are displayed at the amplifier locations by connection to a sweep receiver and oscilloscope. After careful calibration at the head-end, a reference trace is marked on the oscilloscope and subsequent displays are compared to this trace.

Two problems occur in performing this test: one is the need to synchronize the oscilloscope's horizontal deflection with the frequency sweep of the generator source; and a second problem involves simultaneous use of a pilot carrier for AGC action and the swept frequency. If a trap or filter cannot eliminate the interference of the pilot carrier and swept frequencies, it may be necessary to perform this test manually. Synchronous horizontal sweep can usually be achieved if the sweep generator is linear in its frequency variation. Where a sinusoidal frequency change is used, it may be necessary to obtain line voltage for the oscilloscope's horizontal input – and this may be slightly out of phase.

A second method is to insert a calibrated signal generator into the system at the head-end, then read the levels at the test location at the far end of the system and investigate the entire band-width at one or one-half MHz intervals. This is a cumbersome task requiring close coordination between the measurement point and the head-end. It permits the system response to be measured with the amplifiers operating normally.

A valid test of **automatic gain control(AGC)** action requires an extended period of time. To perform this test, a record is made of the various channels' signal level variations over a period of several days, and another record is made simultaneously of the temperature changes. It is essential that these records be accumulated over a period of time in which the temperature varies by at least 50 F. Such test environment conditions would indicate adequate control of the system levels through the effects of an average change in temperature from early morning to mid-afternoon. As many channels as possible should be monitored in order to record any response variation with AGC action, but at least one low-band and one high-band channel should be recorded to observe the control of amplifier tilt versus the temperature-induced change in attenuation and slope. The measurements must be unaffected by changes in measurement equipment line voltage in order to obtain valid data.

Testing Equipment 6

6.1 Signal Level Meter

It is used to measure signal strengths in broadband communication systems. It is a useful tool in CATV operation. It detects RF energy and displays the measurement in decibels relative to one millivolt (dBmV). The signal to be tested is selected by a built-in tuner and the corresponding amplitude is indicated on the meter's LED or LCD readout. The input signal can be tuned by channel or by frequency. The input frequency will range from 50 through 870 MHz and have amplitude sensitivity ranging from minus 35 to plus 60 dBmV. A signal level meter is convenient in measuring signal levels at different points of a distribution system. It is useful in trouble-shooting, and by comparing the signal levels at different points, we know which part of the signal path is out of order. By using the meter with other test equipment, parameters like hum, signal-to-noise ratio, signal leakage and return loss of passive device can also be measured.

6.2 Spectrum Analyzer

Spectrum analyzers are used to measure the incoming signal amplitude on a frequency domain basis. Frequency increases from left to right on a CRT screen while signal amplitude is presented as a series of peaks and valleys. The vertical display is usually calibrated in dBm or dBmV.

An analyzer can be very useful in visualizing input ranging from the satellite broadcasting C-band to lower frequency RF signals traveling through a distribution system. It is a useful test equipment in TVRO, SMATV and CATV installation. The frequency tuning range will be 5 MHz to 4.2GHz, with sensitivity spanning the range of zero to -90 dBmV.

An analyzer is invaluable during a site survey when mapping and measuring any source of terrestrial interference. It can be used to detect the presence of even extremely weak interference down to 60 dB relative to the power of the both satellite and local broadcasts. Many difficulties can be avoided by knowing what signals are being detected by all the satellite and off-air antennas before the headend design is completed.

Interference in the L- band is common where STAR TV is concerned. Examples of the L-band users are microwave links and radar stations. These signals are very strong and might interfere with the satellite system. This will cause interference in channels whose frequencies also fall in the L-band after the LNB. Therefore, a site check with survey horn, LNA, LNB and spectrum analyzer is necessary to pinpoint a particular interference. Some advanced analyzer models are capable of freezing/holding the signal so that checking and identifying it becomes easier. Some can also be connected to printers and provide hard copies of reports.

Scrambling Concepts 7

Scrambling is one of the methods CATV operators use to maintain control over the distribution of their signals. To receive scrambled TV signals, subscribers require a device called a descrambler which allows the operator to collect subscription fees as well as prevent signals being pirated. Some of the common scrambling methods are discussed here to serve as general guidelines for CATV operators when they are planning to upgrade their network.

a. Video Inversion

Entire video and sync waveforms are inverted so that ordinary TV sets cannot detect the signal without a descrambler. The advantage of this technique is that it has simple circuitry and the initial investment is low.

b. Sinewave Sync Shifting

A sinewave is added to the video signal at the line frequency or a multiple of the line frequency so that the synchronization pulses are pushed to a higher level. Television receivers cannot synchronize the video signal and as a result picture quality is distorted. The sinewave also modulates the active video. This means the amplitude of the video must be reduced prior to scrambling so that the scrambled signal falls within transmission voltage limits. A television receiver's sync separation circuitry is not able to distinguish active video from sync information and a descrambler is required.

c. Pulse Sync Shifting

The horizontal and vertical sync pulses are shifted up into the active video region by pulsating signals. The sync pulses are either suppressed or attenuated so that ordinary TV sets cannot lock up the video signal without recovering the sync pulses.

d. Sync Replacement

The horizontal and vertical sync pulses are replaced by digital data. Therefore, normal TV sets cannot detect the normal analogue sync pulses and as a result, a garbled picture is obtained.

e. Active Inversion

The video information is inverted in this technique. This can be done on a line-by-line, alternate line or field-by-field basis, and depends mainly on the requirements. There are two forms of active inversion scrambling — keyed and nokey. The keyed version is less secure as a pulse indicating the video polarity is present in the horizontal blanking interval and is easily detected and descrambled. In the nokey version, no such signal is present and the level of security is increased.

f. Cut and Invert

In this technique, the line video is cut into a number of segments and the polarity of the video is inverted. This system will be more powerful if the digital approach is adopted. A number of European systems have employed the digital version and attained various levels of success.

g. Cut and Rotate

The line video is segmented into a pre-arranged number of segments. The block of segments in the latter part of the line is then rotated to the beginning of the line. The point where the video is cut and rotated is difficult to detect, so this is a very effective scrambling system.

h. Line Shuffle

This is a more complicated form of scrambling. The sequence of lines in a field or frame is altered so that the lines are transmitted in the wrong order. This type of scrambling requires a frame or field store and a good deal of digital circuitry. It is one of the more secure forms of scrambling and is therefore quite attractive to programmers.

Apart from video scrambling, an audio signal is sometimes scrambled to provide a better and more secure system. The audio spectrum is inverted or is digitized and compressed.

The scrambling techniques introduced here are just for reference and do not go into detail. Scrambling techniques are always changing as no system is invincible. The "cat and mouse game" is always on, and more sophisticated systems are regularly required. Since most systems are sold on a turnkey basis, cable operators do not have to worry about the techniques. Manufacturers' design engineers will select the appropriate technique for clients' demands and investment.

More advanced techniques, involving the use of a smart card and an addressable system wherein an operator can control accessibility by disabling any customer's descrambler, are available on the market. Cable operators need to decide the cost of head-end equipment, installation and, most importantly, the price of the descrambler. The price of the descrambler should be reasonable and affordable to subscribers for the business to succeed.

The above explanation and discussion points are provided for general reference and to serve as basic guidelines. For more detailed information and advice on specific cases, please contact the appropriate STAR TV Representatives of Trade Marketing and Distribution, STAR TV, Hong Kong.

Any enquiries from:

Indian Sub-Continent
South East Asia
Middle East

Greater China
Hong Kong
Japan
Korea
Macau
Taiwan

Please contact:

Mr Allan Ng
Senior Marketing Executive
Trade Marketing & Distribution

Mr John Leung
Marketing Manager
Trade Marketing & Distribution

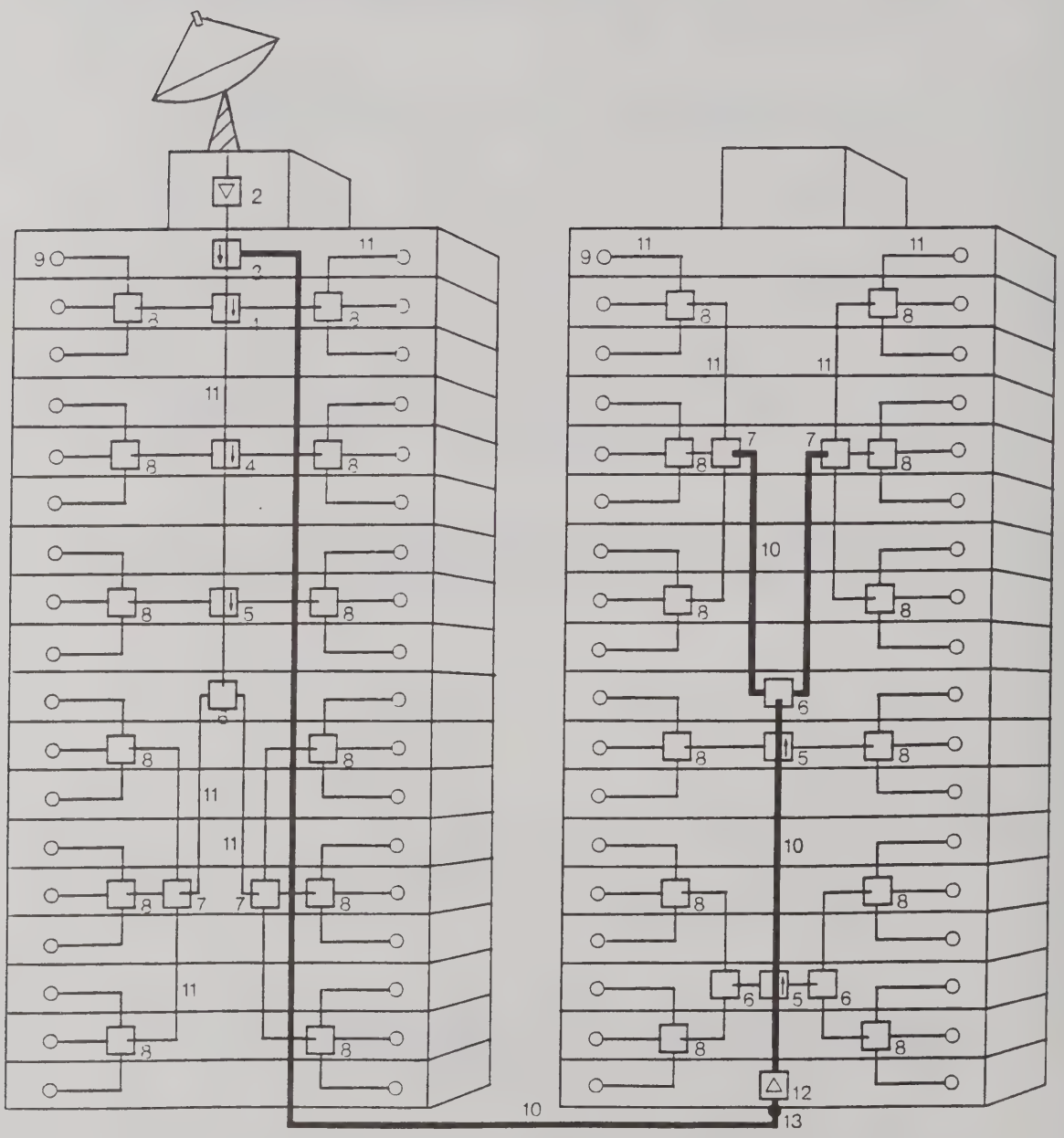
At the following address:

STAR TV, 9/F Hutchison House, 10, Harcourt Road, Central, Hong Kong.
Tel: (852) 532-1888 Fax: (852) 524-4093

Appendices

8

8.1 Diagram of a small CATV system for two blocks with 18 floor each.



8.2 Transmission Frequency Range for TV Signals.

Band	Channel	Frequency (MHz)	Picture carrier (MHz)	Sound carrier (MHz)
VHF I	2	47…54	48.25	53.75
	3	54…61	55.25	60.75
	4	61…68	62.25	67.75
Lower	S4	125…132	126.25	131.75
Special	S5	132…139	133.25	138.75
Channel	S6	139…146	140.25	145.75
	S7	146…153	147.25	152.75
	S8	135…160	154.25	159.75
	S9	160…167	161.25	166.75
	S10	167…174	168.25	173.75
VHF III	5	174…181	175.25	180.75
	6	181…188	182.25	187.75
	7	188…195	189.25	194.75
	8	195…202	196.25	201.75
	9	202…209	203.25	208.75
	10	209…216	210.25	215.75
	11	216…223	217.25	222.75
	12	223…230	224.25	229.75
Upper	S11	230…237	231.25	236.75
Special	S12	237…244	238.25	243.75
Channel	S13	244…251	245.25	250.75
	S14	251…258	252.25	257.75
	S15	258…265	259.25	264.75
	S16	265…272	266.25	271.75
	S17	272…279	273.25	278.75
	S18	279…286	280.25	285.75
	S19	286…293	287.25	292.75
	S20	293…300	294.25	299.75
Extended	S21	302…310	303.25	308.75
Special	S22	310…318	311.25	316.75
Channel	S23	318…326	319.25	324.75
	S24	326…334	327.25	332.75
	S25	334…342	335.25	340.75
	S26	342…350	343.25	348.75
	S27	350…358	351.25	356.75
	S28	358…366	359.25	364.75
	S29	366…374	367.25	372.75
	S30	374…382	375.25	380.75
	S31	382…390	383.25	388.75
	S32	390…398	391.25	396.75
	S33	398…406	399.25	404.75
	S34	406…414	407.25	412.75
	S35	414…422	415.25	420.75
	S36	422…430	423.25	428.75
	S37	430…438	431.25	436.75
	S38	438…446	439.25	444.75
	S39	446…454	447.25	452.75
	S40	454…462	455.25	460.75

Transmission Frequency Range for TV Signals. (cont'd)

Band	Channel	Frequency (MHz)	Picture carrier (MHz)	Sound carrier (MHz)
UHF BAND IV/V	S41	462…470	463.25	468.75
	21	470…478	471.25	476.75
	22	478…486	479.25	484.75
	23	486…494	487.25	492.75
	24	494…502	495.25	500.75
	25	502…510	503.25	508.75
	26	510…518	511.25	516.75
	27	518…526	519.25	524.75
	28	526…534	527.25	532.75
	29	534…542	535.25	540.75
	30	542…550	543.25	548.75
	31	550…558	551.25	556.75
	32	558…566	559.25	564.75
	33	566…574	567.25	572.75
	34	574…582	575.25	580.75
	35	582…590	583.25	588.75
	36	590…598	591.25	596.75
	37	598…606	599.25	604.75
	38	606…614	607.25	612.75
	39	614…622	615.25	620.75
	40	622…630	623.25	628.75
	41	630…638	631.25	636.75
	42	638…646	639.25	644.75
	43	646…654	647.25	652.75
	44	654…662	655.25	660.75
	45	662…670	663.25	668.75
	46	670…678	671.25	676.75
	47	678…686	679.25	684.75
	48	686…694	687.25	692.75
	49	694…702	695.25	700.75
	50	702…710	703.25	708.75
	51	710…718	711.25	716.75
	52	718…726	719.25	724.75
	53	726…734	727.25	732.75
	54	734…742	735.25	740.75
	55	742…750	743.25	748.75
	56	750…758	751.25	756.75
	57	758…766	759.25	764.75
	58	766…774	767.25	772.75
	59	774…782	775.25	780.75
	60	782…790	783.25	788.75
	61	790…798	791.25	796.75
	62	798…806	799.25	804.75
	63	806…814	807.25	812.75
	64	814…822	815.25	820.75
	65	822…830	823.25	828.75
	66	830…838	831.25	836.75
	67	838…846	839.25	844.75
	68	846…854	847.25	852.75
	69	854…862	855.25	865.75

8.3 Demodulator

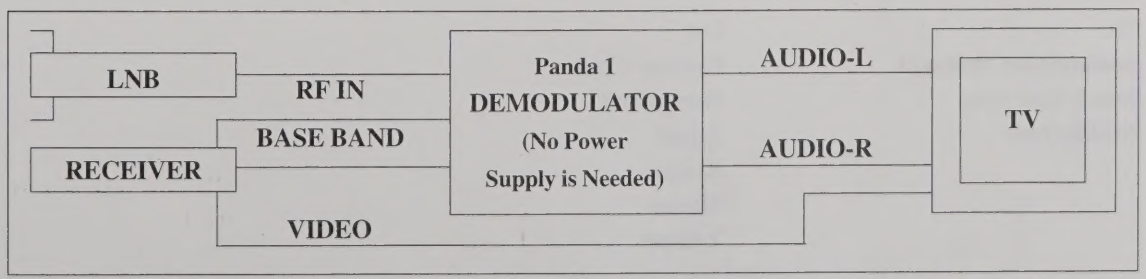
Features:

- The Demodulator provides access to the multi-language sub carriers available on AsiaSat. By electronically processing the "Panda 1" audio signals consumers can enjoy the superior quality sound provided by Star TV.

Preliminary Specifications:

Audio Frequency Range	**MTI 9200-N** **(NTSC System)** ST1 5.58/5.76 MHz ST2 5.94/6.12 MHz ST3 6.30/6.48 MHz M1 5.94 MHz M2 6.12 MHz M3 6.30 MHz M4 6.48 MHz	**MTI 9200-P** **(PAL System)** ST1 6.30/6.48 MHz ST1 6.66/6.48 MHz ST1 7.02/6.48 MHz M1 6.66/ MHz M2 6.84/ MHz M3 7.02/ MHz M4 7.20/ MHz
Baseband Input	1.5 ± 0.2 V (Peak to Peak over Operating Range)	
Supply Voltage Range	15 V – 23 V (From Receiver)	
Current Comsumption	80 m/A (Max.)	
Harmonic Distortion	1.5% (Max.)	
Dimensions	160mmH X 200mmW X 40mmD	

System Installation Drawing:



8.4 Reply Form

Name of Company : _____

Contact Name : _____ Contact Title : _____

Address : _____

_____

City : _____ State : _____

Country : _____

Phone : _____ Fax : _____

Principal Nature of Business : _____

1. What kind of system do you operate?
   _____ CATV _____ SMATV _____ MMDS _____ TVRO

2. Have you read STAR TV's technical manual? _____ Yes _____ No

3. Did you find the information sufficient? _____ Yes _____ No
   If no, please indicate what information you would like.
   _____
   _____
   _____

4. Please indicate what information you would like to receive from us regarding our new Pay-TV channels?
   _____
   _____
   _____
   _____

5. What other means of support could STAR TV provide you with to enhance your business?
   _____
   _____
   _____

Please complete and return a photocopy of this form by fax or by post to STAR TV.
Upon receipt of your completed form,we will send you a set of STAR TV channel stickers.

STAR TV 9/F Hutchison House, 10 Harcourt Road, Central, Hong Kong.
Telephone: 852 532-1888 Fax: 852 524-4093

Attn:

Shaleen Vasvani

For
Indian Sub-Continent
South East Asia
Middle East

Tammy Tang

For
Greater China
Hong Kong
Japan
Korea
Macau
Taiwan

For further information on STAR TV Network, please contact:

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